

REMARKS

The Office Action dated April 30, 2003 has been received and carefully noted. The period for response having been extended from July 30, 2003 until August 30, 2003 by the attached Petition for Extension of Time, the above amendments, corrected drawings, and the following remarks are submitted as a full and complete response thereto.

New, formal drawings are submitted to address deficiencies noted on page 2 of the Official Action. The specification has been amended to be in compliance with United States patent practice and changes to the drawings. Claims 23-28, 30-33, 35, 38, 41 and 44 have been amended to more particularly point out and distinctly claim the subject matter of the invention. Claim 39 has been cancelled without prejudice. New claims 45-49 are submitted to recite aspects of the invention which were disclosed but not claimed in the application as originally filed. No new matter has been added. Claims 23-38 and 40-49 are respectfully submitted for consideration.

The drawings were objected to on the grounds that Figures 1-3 should be designated by a legend such as prior art, and due to the fact that Figures 1 and 3 required appropriate functional names for the elements. In compliance with the new rules for submitting drawing corrections, submitted herewith are formal corrected drawings which address the deficiencies noted in the Official Action. With respect to Figure 1, a "legend" has been provided which indicates that reference number 4 refers to cells, reference number 6 refers to base stations, and reference number 8 refers to terminals.

Additionally, multiple elements in Fig. 3 were labeled with the same numeral although the elements were not identical in that figure; the other element is now designated by another numeral so that the proper distinction could be maintained. It is respectfully that the drawings are now in compliance with United States patent practice.

The specification was objected to on the grounds that it must be divided into appropriate sub-sections. As noted above, the specification has been amended to include the headings as noted in the Office Action, and as required by § 608.01 of the MPEP. Additionally, sections of the specification were also amended to comport with the changes to the drawings.

Claims 23-44 were rejected under 35 USC § 112, second paragraph, as being indefinite. The Official Action highlighted numerous deficiencies in the claims. Applicant appreciates the Examiner's highlighting these deficiencies, and respectfully submit that all of claims 23-38 and 40-44 have been amended as appropriate to cure these deficiencies.

Claims 23-25, 28-31, 33, 37-40 and 42-44 were rejected under 35 USC § 102(b) as being anticipated by Carney (U.S. Patent No. 5,937,011). Claims 23-27 and 29-44 were separately rejected under 35 USC § 102(e) as being anticipated by Helms (U.S. Patent Publication No. 2001/0014592). Applicant respectfully submits that these claims recite subject matter which is neither disclosed nor suggested in the cited prior art.

Claim 23, upon which claims 22-38 and 40-43 are dependent, recites a multi-frequency carrier transmitter comprising input means for receiving a plurality of different

digital signals to be transmitted, with the different digital signals to be transmitted on different carrier frequencies. Digital modulators are provided for modulating the different digital signals at the respective frequencies. Digital to analog converter means are provided for converting a composite digital signal comprising the different digital signals at the respective carrier frequencies to analog form, thereby generating a composite analog signal. Amplifier means are provided for receiving and amplifying the composite analog signal. Predistortion means are provided for predistorting the plurality of digital signals during or after modulation of the different digital signals by the digital modulators, and prior to amplification of the composite digital signal by the amplifier means. The predistortion provided by the predistortion means is subsequently altered in dependence on a difference between the input signals and the output at the amplifier means.

Independent claim 44 is directed to a multi carrier frequency transmission method comprising receiving a plurality of different digital signals to be transmitted, with the different signals to be transmitted on different carrier frequencies. The different digital signals are modulated at the respective frequencies. The plurality of different digital signals are combined to provide a composite digital signal comprising the different signals at the respective carrier frequencies. The composite digital signal is converted to analog form, thereby generating a composite analog signal. The composite analog signal is then amplified, and the plurality of different digital signals are predistorted prior to amplification of the composite analog signal by the amplification means during or after

the modulation step. The predistortion applied to subsequent digital signals is altered in dependence on the difference between the different signals and the amplified signals.

As a result of the claimed invention, a transmitter and method is provided wherein only a signal transmit path is used, and wherein problems associated by a non-linear amplifier regarding power leakage can be avoided. It is respectfully submitted that the prior art of Carney and Helms fails to disclose or suggest the claimed invention.

Carney discloses a multi-carrier high power amplifier using digital pre-distortion. The technique of Carney is directed to distortion correction for use with a high power amplifier in a multi-carrier radio signaling system which might include a cellular base station. Referring to Figure 1 and the corresponding discussion on column 3, lines 54-60 of Carney, predistorter 14 operates by taking, as inputs, the composite base band signal 125 generated by the digital combiner 122. Predistorter 14 is disclosed in Carney as "consisting of" a lookup table 140, predistortion processor 142, combiner sample buffer 144, and HPA sample buffer 146. The inputs to the predistorter also include digitized HPA output signal 150, and produces data for look-up table 140 and a calibration signal 148. It is respectfully submitted, however, that Carney is significantly different from the invention as recited in the presently pending claims; the presently pending invention recites a digital to analog converter means which converts a composite digital signal comprising a plurality of different digital signals at respective carrier frequencies to analog form, thereby generating a composite analog signal. Carney discloses no such apparatus, and performs no such step. The predistortion means of the present invention

predistorts the plurality of digital signals during or after modulation of different digital signals by the digital modulators, and prior to amplification of the composite digital signal by the amplifier means. The predistortion provided by the predistortion means are subsequently altered in dependence on a difference between the input signals and the output at the amplifier means. It is respectfully submitted that a person of skill in the art would understand the apparatus and method of Carney to be significantly different than that of the present invention. The embodiments of the present invention output one or more phase and amplitude coefficients to predistort each of the one or more digital signals independently; this configuration enables the transmitter to compensate for both phase and amplitude variations in each of the plurality of signals.

Helms discloses a transmitter for a plurality of carriers of a broad-band transmitting spectrum. Referring to Figure 4 of Helms, a transmitter is shown wherein a plurality of digital upward conversion units receive predistorted signals from respective predistortion units. The predistortion units PD1...PDn process input signals in_1 to in_n . The predistortion of the input signals are set to correspond to set point selections of a storage unit LUT. In other words, each predistortion unit receives a carrier-related input signal which is digitized and allocated to one of the carriers as discussed in paragraph 28 and as illustrated in Figure 2. However, the signals of Helms require modulation to an intermediate frequency prior to summation. This modulation step is being performed by the digital upward conversion unit, therefore the digital upward conversion units of Helms are considered to be modulators. However, Helms clearly illustrates adaptive


predistortion being performed before modulation of the input signals. This is a significant difference from the present invention, which recites predistortion of a plurality of different digital signals during or after modulation of the different signals by a plurality of modulators. Furthermore, claim 1 clearly recites that the modulators modulate the different signals at the respective frequencies, thereby performing substantially the same function of the digital upward conversion units of Helms. Due to this significant structural and functional difference, the transmitter of the present invention does not require downward conversion units, or DDC, as required by the configuration of Helms and as clearly visible in Figure 4. In the present invention, predistortion is performed upon the modulated signals, so that the predistortion feedback path does not require demodulation means. As a result, the present invention has a significantly reduced number of functional elements within the transmitter, and therefore provides improved reliability and simplicity.

Applicant respectfully submits that Carney and Helms disclose differing solutions to the problem of transmitting data in a multi-carrier system. These solutions are significantly different than that which is recited in the present claims. Applicant respectfully submits that these distinctions are more than sufficient to render the claimed invention unobvious to a person of ordinary skill in the art. Applicant therefore requests that each of claims 23-38 and 40-49 be found allowable, and this application passed to issue.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicant's undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicant respectfully petitions for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,



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Enclosures: Petition for Extension of Time
Corrected Formal Drawings - 6 sheets